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This is an unscheduled ATM dealing with the test and evaluation of the CPLEE, conducted by a BxA Suited subject at the Mission and Crew Engineering test facility on 7 July 1967.

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A. Purpose

The purpose of this test was to evaluate the shadowgraph device proposed by BRLD and incorporated by them on the E-2 (Training) Model of the CPLEE.

The following sections of this ATM describe the hardware, facilities and test procedures as well as the results and recommendations derived from the test.

B. Test Description

1. Hardware - BRLD E-2 (Training model of the CPLEE, Mission and Crew Engineering mockup of the Experiment Handling Tool (EHT), and 1,000 watt collimated light source (simulated solar light source).

2. Facilities - Pressurized, suited subject, operating on a simulated lunar surface.

Shirt sleeve manipulation of the CPLEE against a black background and with the collimated light source.

3. Procedures - Because the CPLEE/ALSEP pallet mounting brackets (Flight 3 Configuration) have not yet been designed. Mission and Crew Engineering did not have available the mounting points for the CPLEE. Therefore, of necessity, the test deployment of the CPLEE began with the CPLEE resting on a simulated pallet (upside down, as it will be stowed on the pallet) with the fasteners undone. (In the actual deployment the astronaut's first task will be to undo three fasteners prior to lifting the experiment from its in-flight stowage location.)

First, the CPLEE was lifted by one of the three leveling legs using the right hand and in so doing the leg was extended about 6.5 inches, (see Figures #1 through #5). Next the suited subject

turned the CPLEE right side up using the left hand, grasped the EHT with the right hand, and inserted the EHT into the socket on the top with the handle pointing backward toward the cable reel. The shank of the EHT was then grasped with the left hand and the two remaining legs extended with the right hand, following which the EHT handle was once again grasped with the right hand. An attempt was made by the suited subject to extend and pivot the legs in such a manner that when the experiment was placed on the lunar surface it would be nearly level. The traverse with the experiment was not simulated because the cable between the CPLEE and the central station had not yet been attached. The experiment was emplaced using the "E" and the arrow on the top of the experiment as a guide as to which side of the experiment was to be oriented in an easterly direction. Finally, the experiment was leveled, but it was not aligned because the shadowgraph alignment device could not be seen by the standing astronaut.

C. Results

No new problems were discovered during the manipulation of the experiment prior to insertion of the EHT. The subject carried the experiment approximately 10 feet from the point at which it was retrieved from the simulated tie-down and extended the legs to some angle prior to emplacement. As is mentioned above, he oriented the experiment using the orientation marks (the "E" and the arrow) in the appropriate direction (toward the light source) and attempted to level the instrument. The CPLEE mockup was eventually leveled to within $\pm 3^{o}$; however, the subject stated that this task appeared difficult because of the rocking motion required on the simulated lunar surface. The legs tended to dig into the surface and provided very little resistance against which the thermal plate could be rocked.

After emplacement and leveling was accomplished, the subject was asked to report the orientation to the required tolerance. He reported that he could not see the shadow nor could he read the indication. It was decided to have the suited subject retreat to a point where he could view the face of the shadowgraph and this distance was approximately

10 feet away. He could still not read the shadowgraph because of a combination of factors such as (1) distance, (2) viewing angle and (3) color contrast.

It was noted during these tests that a sharp shadow was cast against the vertical face of the electronics box (see Figure #7) and that this shadow was readily viewable by an astronaut standing in proximity to the instrument (as would be necessary for maintaining the compatibility between leveling and alignment).

It was decided to test this aspect as a possible shadowgraph indicator by partially extending the telescoping legs and taping them to prevent further motion. This resulted in the simulation of non-extendable legs which were longer than the stowed leg but not as long as the fully extended ones. The ball joints of the legs were extended to the full limit of angular travel with the single leg pulled directly out (i.e., zero horizontal angle from the longitudinal) centerline of the experiment. This effectively negated the ball joints and permitted testing of the leveling capability by imbedding the legs into the simulated lunar surface rather than by rocking the thermal plate. The results of this test were that the suited subject was able to emplace and level the experiment much more rapidly and positively than when using the ball joint mechanism. Also, a wider footprint was realized with the fixed leg than might be possible with ball joints; and, by reducing the overall length of the leg, the CG is brought closer to the surface with the inherent enhancement of stability.

There was one drawback to the use of this leg as the shadowgraph device. This related to the combination of a bead on the vertical face of the CPLEE and the lightening holes in the legs can cause a misjudgment of the orientation reading.

Because of this, the idea of using the shadow from the leg was discarded. Another test is being readied to study the possibility of using the shadow cast by the shank of the EHT and its results will be published in the near future.

D. Recommendations

Based on the results of the tests performed using the E-2 Training Model, Bendix Mission and Crew Engineering suggests that the shadowgraph proposed by BRLD be dropped from consideration and that the shadow cast by the shank of the EHT be given prime consideration as the shadowgraph gnomon. This would require the incorporation of marks on the dust cover. The color coding of these marks would require specific

attention in terms of contrast. This information is available from the M & C Engineering group.

Finally, since it simplifies the astronaut's task loading, results in shorter deployment time, reduces complexity and enhances stability, it is recommended that consideration be given to the possibility of incorporating the fixed joint single position leg. Figure #6 provides the recommended angle relationship if this approach proves desirable.

Figure 1

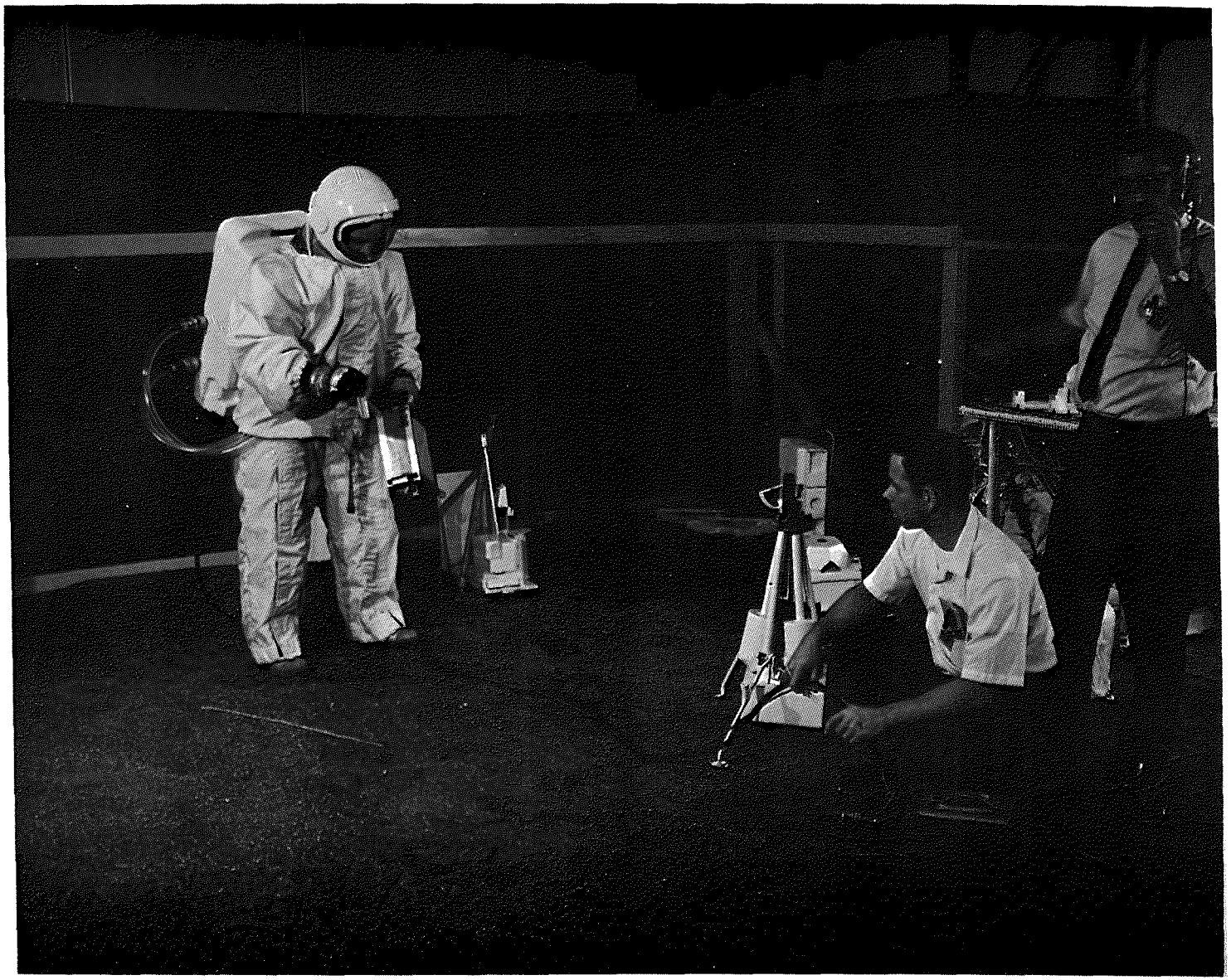

Figure 2

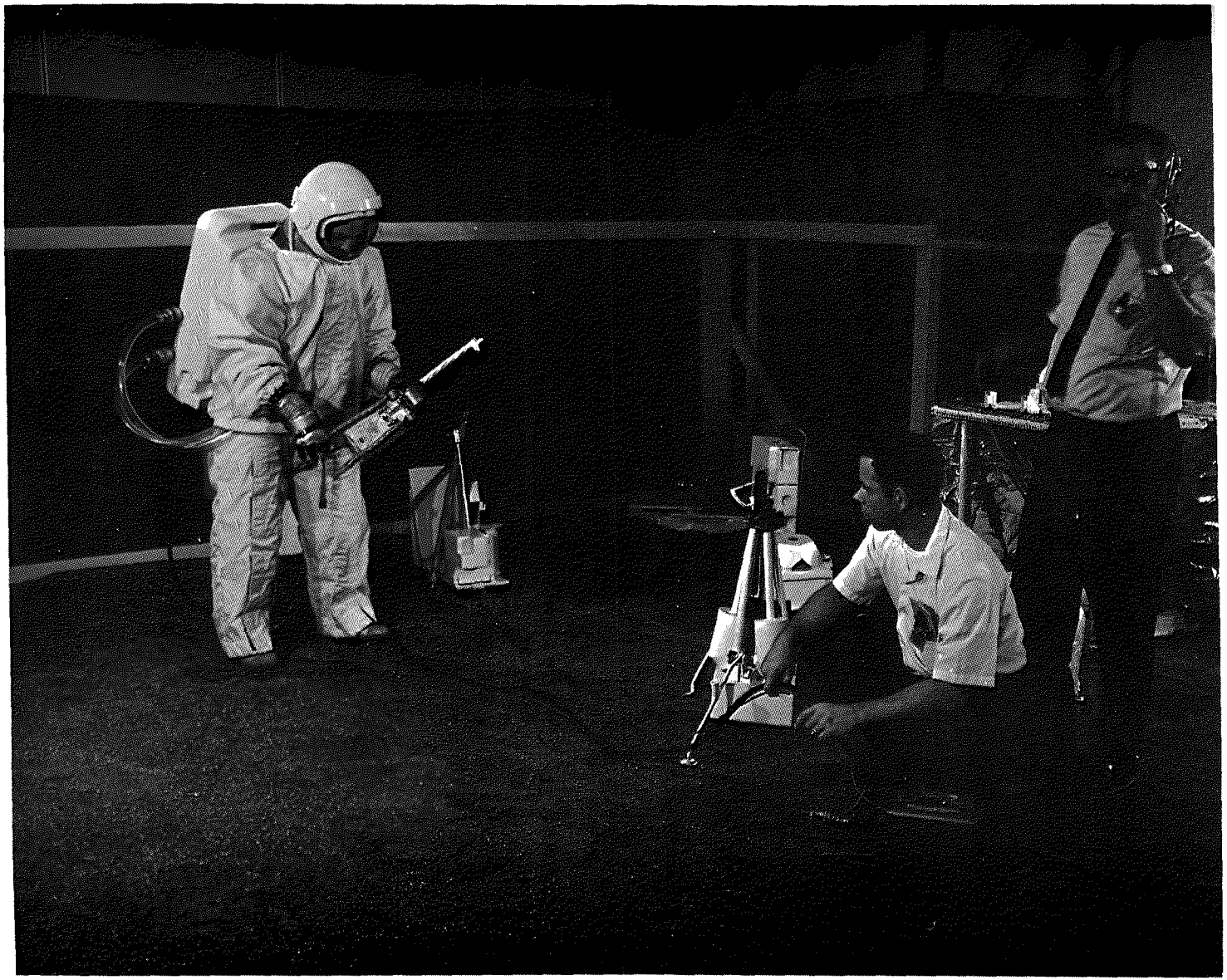

Figure 3

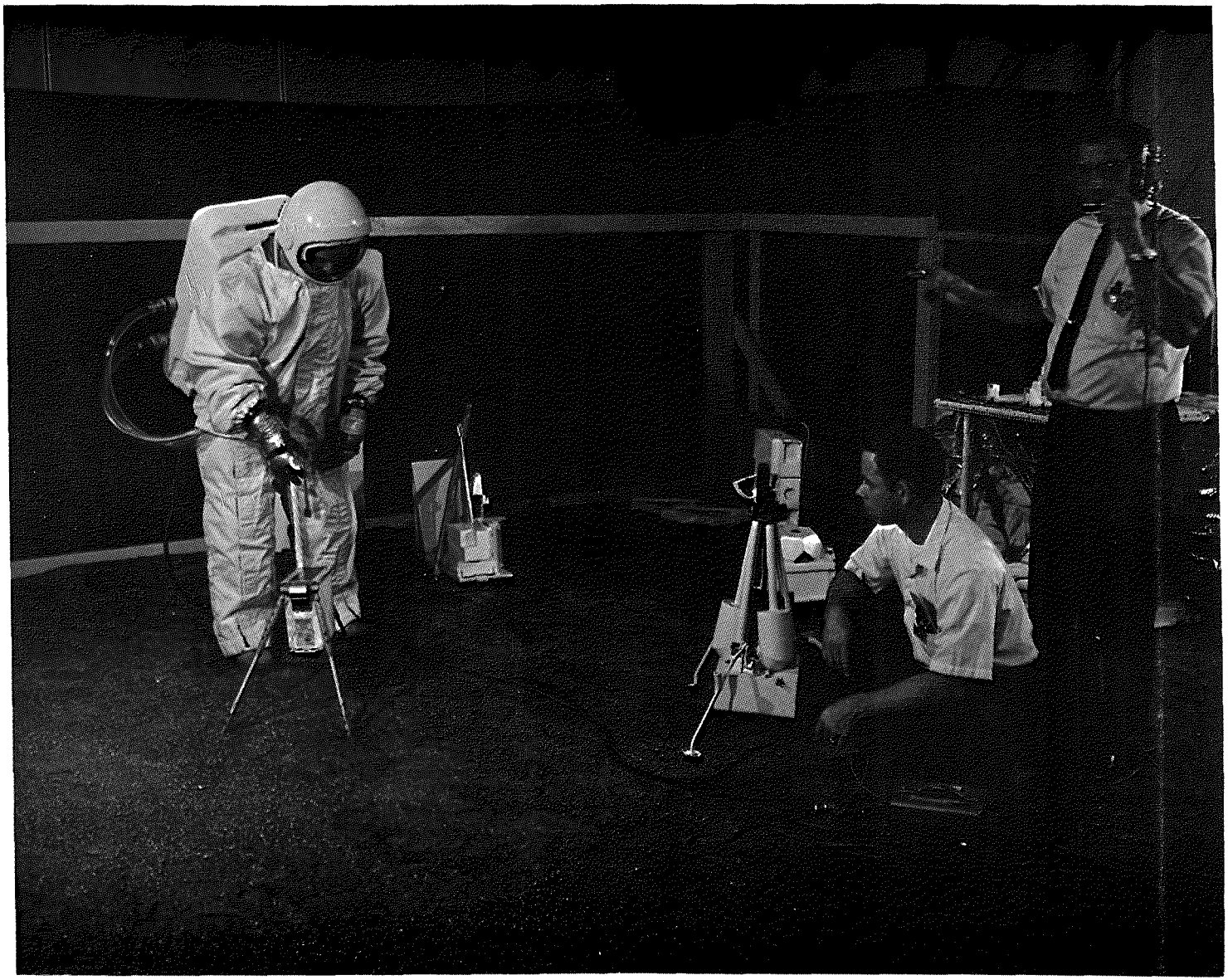

Figure 4

Figure 5

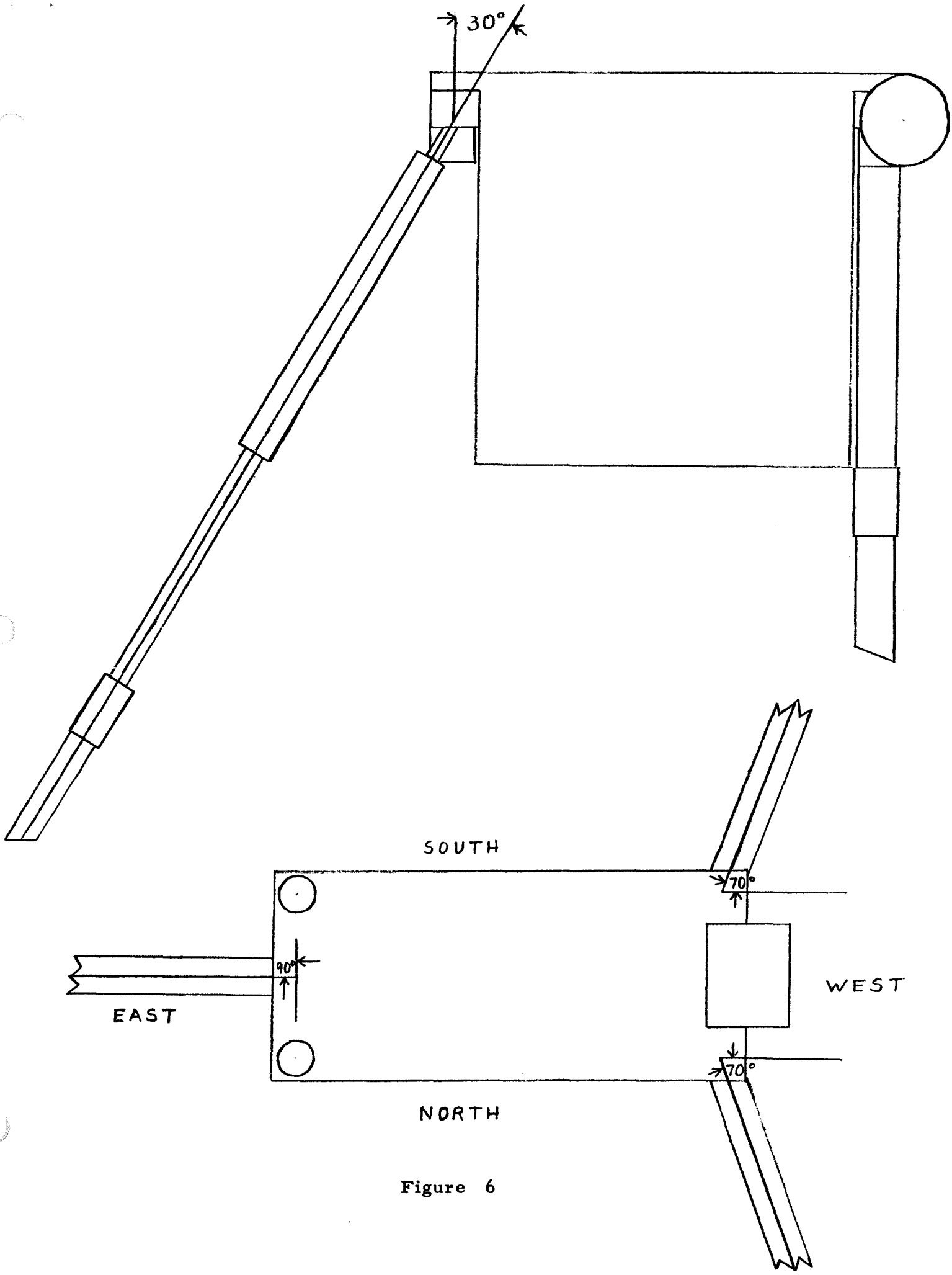

Figure 6

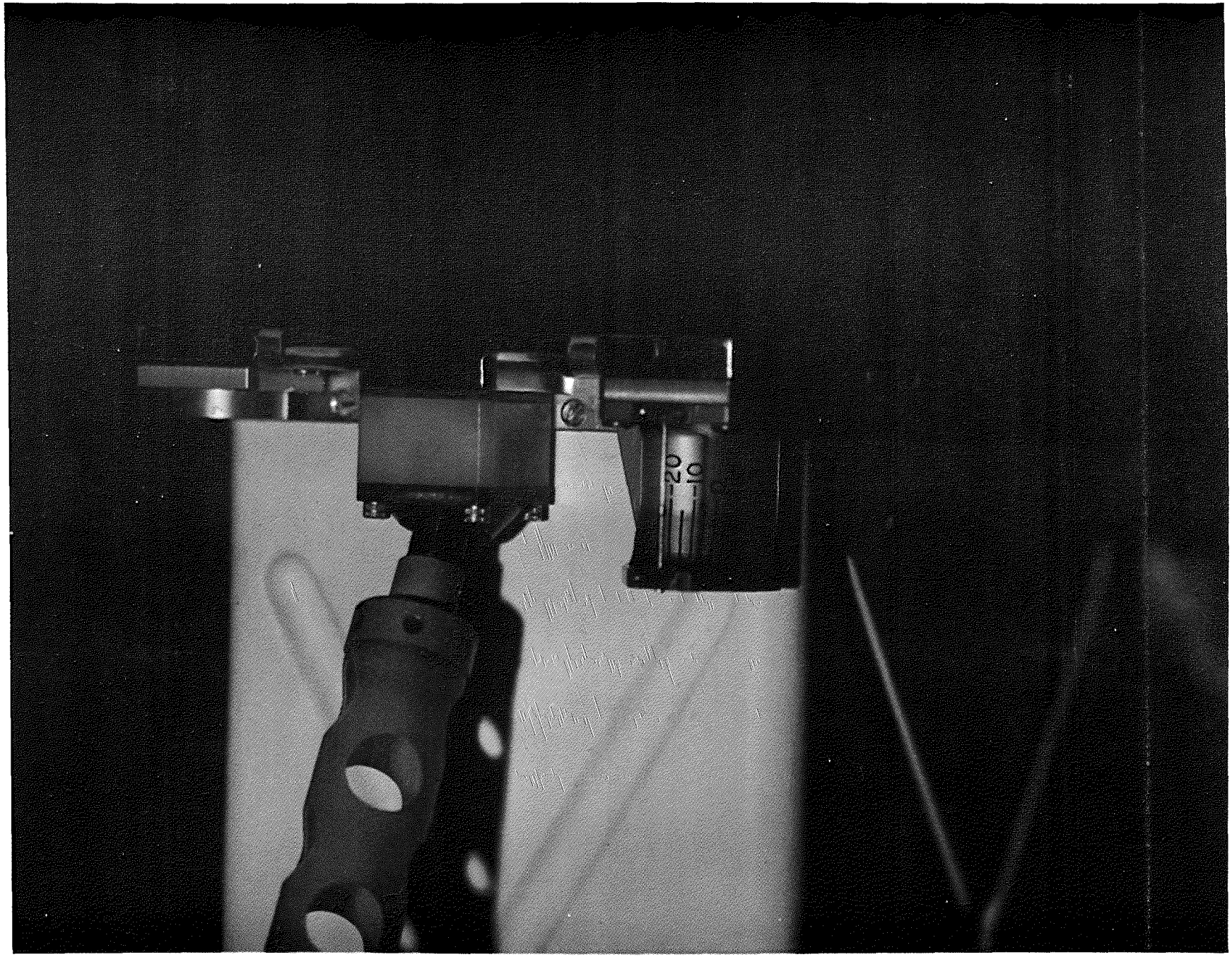

Figure 7